





### **Healthcare Textiles and Laundry 101:**

Management in Acute Care and Residential Care

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## **Today's Topics**



- · Healthcare textiles:
  - Epidemiology and microbiology
  - Infectious disease transmission principles
- · Healthcare textile Laundry
  - Review of the process
  - Soil/pathogen removal vs. pathogen inactivation
- · Your questions:
  - Textile management in Isolation care areas
  - Blood and OPIM contaminated textiles
  - Scrubs and uniforms, PPE
  - Textile/fabric item management in residential care
    - Resident clothing
    - Upholstered furniture



#### **Healthcare-Associated Infections** (HAIs) in the U.S.



- HAIs are an important public health problem.
- · Approximately 1 out of every 20 hospitalized patients will contract an HAI.
- In 2002, ~1.7 million HAIs were identified
  - · 33,269 in NICU infants, 19,059 in nursery infants
  - · 417,946 in adults and children in ICUs
  - · 1,226,857 in adults and children in general patient care areas
- From a 2009 report: HAIs cost \$35.7 \$45 billion in 2007
- · Major disease agents:
  - Acinetobacter, Burkholderia, antibiotic-resistant strains of Staphylococcus (e.g., MRSA), Enterococcus (e.g., VRE), Clostridium, Enterobacteriaceae (e.g., CRE, carbepenumresistant K. pneumoniae)

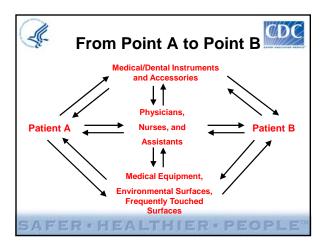
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### What is the Purpose of Environmental Infection Control?



- Environmental management is only one of many infection prevention tasks
- Infection prevention:
- · Interrupt potential transmission of infectious agents
  - Patient to patient
  - · Patient to healthcare worker
  - · Patient to healthcare worker to patient
  - Healthcare worker to healthcare worker
  - · Medical/dental instruments, devices, fomites, surfaces
  - · Aerosols in air; water; food
- · Modes of transmission of main concern
  - Direct, person-to-person
  - Indirect involving an intermediate entity (e.g., surface, reservoir)
- Hand transfer of contamination is important



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### #Basic Strategy Elements for Preventing and Eliminating Contamination of Environmental Surfaces

- □ Prevent environmental surface contamination
  - Handwashing / hand hygiene
  - Use of barrier coverings on clinical touch surfaces
  - Responsible use of gloves, personal protective equipment (PPE)
  - Clean-to-dirty work flow whenever practical
    - · Avoid dirty-to-clean work flow as much as practical
- □ Remove environmental surface contamination
  - Cleaning
- □ Inactivate environmental surface contamination
  - Disinfection for inanimate surfaces
  - Antisepsis for living tissue

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### **Laundry and Infectious Diseases**



- Textiles contaminated with body substances can contain large numbers of microorganisms (10<sup>6</sup> – 108 cfu/100 cm<sup>2</sup> fabric)
- Few reports in the literature link laundry to disease transmission when proper procedures are followed
- Annual estimates for volume of laundry processed in U.S. health care: >10 billion lbs. (5 billion lbs. in the late 1980s)
- Continue current infection prevention practices

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### **Epidemiologic Observations: Healthcare Textiles and Infection**



- · Of all the surfaces in a hospital, a patient will have the greatest degree of contact with his gown and the bed linens
- Despite studies documenting presence of microbes on textiles, little documentation of actual transmission
  - Rhizopus outbreak in U.S., 2009
  - Bacillus cereus outbreaks in Japan, 2000 2005,
- · Difficult to measure a rare event



# Pathogens on Healthcare Attire



- · Physicians' white coats
  - Wong D, et al. Brit Med J 1991; 303: 1602-4
  - Treakle AM, et al. Am J Infect Control 2009; 37: 101-5
- - Biljan MM, et al. Brit Med J 1993; 307: 1582-4
- Lopez PJ, et al. Am J Infect Control 2009; 37: 79-80
- · Medical students' coats
  - Loh W, et al. J Hosp Infect 2000; 45: 65-8
- · Nurses' uniforms
  - Babb JR, et al. J Hosp Infect 1983; 4: 49-57
  - Perry C, et al. J Hosp Infect 2001; 48: 238-41



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### **Observations from a Recent** Study



- 135 personnel (45% physicians, 55% nurses) in surgical depts. (60%) and medical depts. (40%)
- Nonpathogenic skin organisms isolated from all attire tested
- Rate of contamination with pathogens higher in attire changed every 2 days compared to that for daily changes (p<.05)</li>
- Isolated pathogenic bacteria:
  - Acinetobacter spp. 37% (89/238 cultures)
  - Staphylococcus aureus 13% (32/238 cultures)Enterobacteriaceae 8% (18/238 cultures)
  - Pseudomonas aeruginosa 3% (8/238 cultures)
- Only skin bacteria isolated from 4 uniforms cultured immediately after receipt from the hospital laundry
  - Bacterial loads significantly lower than on uniforms being worn

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# Survival of Microorganisms on Textiles



- □ Neely and Maley: J Clin Microbiol 2000; 38: 724-726 • Gram positive bacteria can survive on various fibers / healthcare
  - apparel from days to months
  - Smaller bioburden shorter survival time
  - Increased survival to shorter survival times:
    - · Cotton: Entercoccus faecium > E. faecalis > CNS > S. aureus o > 90 days > 33 days > 21 days > 21 days
    - Polyester: E. faecium > E. faecalis > S. aureus > CNS
      - > 90 days > 80-90 days > 40-56 days > 20-22 days
- □ Neely and Orloff: J Clin Microbiol 2001; 39: 3360-3361
  - Medically-important fungi survive on fibers and apparel
  - Cotton, polyester:
    - Aspergillus (> 30 days) > Fusarium (10 days) > Candida (1-8 days)



## Some Observations About Textiles and Microorganisms in Health Care



- Perry C, et al. J Hosp Infect 2001; 48:238-241
  - Microbial sampling of HCW uniforms during normal wear
  - S. aureus was the only bacterium to have high counts (e.g., 10-100 CFU and > 100 CFU)
  - Surgery uniforms S. aureus; Medicine and renal uniforms S. aureus, VRE, and C. difficile
  - Increasing numbers of S. aureus on uniforms when worn for more than one day
- □ Takashima M. et al. Am J Infect Control 2004: 32: 27-
  - Binding ability: microorganisms to fibers (100 mg), high conc.
  - Cotton: S. aureus 2%, MRSA 1%, Pseudomonas aeruginosa 8.1%
  - Polyester: S. aureus 96.2%, MRSA 87.9%, P. aeruginosa 99.9%

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#### **Current Healthcare Textiles** Standard in the U.S.



- Standard for reusable textiles: Hygienically clean
- Not quantified for microorganisms, but assume textiles are generally rendered free of vegetative pathogens
  - Through a combination of soil removal, pathogen removal, pathogen inactivation, contaminated laundry is rendered hygienically clean
  - · Carries negligible risk to healthcare workers and patients, provided that the clean textiles are not inadvertently contaminated before use
- · Reusable surgical textiles: Sterilized

CDC Guidelines for Environmental Infection Control in Health-Care Facilities, 2003:

http://www.cdc.gov/hicpac/pdf/guidelines/eic in HCF 03.pdf

ANSI/AAMI ST79:2010 and A1; ANSI/AAMI ST65:2008



### Key Concepts in Quality for **Healthcare Textiles**



- Functional separation
  - Separation of soiled sort/soiled textile areas from clean textile areas
  - Primarily accomplished via structural design and ventilation specifications
  - Conceptually also can include work practices to keep clean textiles separate from soiled textiles
- · Hygienically clean textiles
  - Contact with clean surfaces at minimum
  - Disinfected surfaces may be indicated



### **Main Steps of Healthcare Laundry Processing**



- · Collection of soiled textiles at point of use
- · Transport to laundry
- · Wash cycle:
  - Flush, main wash, bleaching, rinsing, souring
- · Dried and pressed
- · Packaged, loaded into carts
- · Delivery back to the hospital

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## **Laundry Operations**



- If using hot water washing, water temperature ≥71° C (≥160° F) is needed
- Some healthcare facilities may not have access to water at this temperature
- Chlorine bleach (50 150 ppm) is effective laundry additive at various water temperatures
  - Follow manufacturer instructions for bleach use
- One of the rinses includes a mild acid (sour) to neutralize residual alkalinity from the wash
  - · Helps to inactivate microorganisms
  - Reduces risk of skin reaction to alkali

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## Alternatives to Hot-water Laundry



- In-house laundries consume an average of 50% 70% of the facility's hot water (10% - 15% of the total energy used)
- · Water temperature may be regulated locally
- Lower temperature (e.g., 22° 50° C) wash cycles can be used with appropriate detergents and laundry additives
- New detergents and processes (e.g., oxidative products) are being evaluated in Europe
- · Current problems associated with bleach use:
  - Not all fibers and fabrics are compatible with bleach
  - Chlorine + residual chlorhexidine gluconate (CHG) = brown



### **Conventional Laundering:** Log Reductions in Bioburden



- · In the wash, rinse cycles:
  - Agitation: ~3 log unit reductions
  - Addition of bleach: ~ 3 log unit reductions
- In the dry cycle:
  - ~ 1 2 log unit reductions

From: Blaser MJ, et al. 1984; J Infect Dis 149: 48-57.

- Post wash microbial burden ~10 100 CFU/cm<sup>2</sup>
- · Predominantly Gram-positive organisms

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#### The Laundry Process: Log Reductions

Process	Gram Positive LR	Gram Negative LR
Pre –wash at 35° C	0.73 – 2.47	0.70 - 1.16
Main wash at 45° C w/o pre-wash	0.97 - 2.58	1.11 - 2.66
Main wash at 60° C w/o pre-wash	1.34 - >5.56	3.71 - >5.6
E60 + 35: pre-wash at 35° C, main wash at 60° C	1.91 - >7.68	>5.6 - >7.76
Completed main wash at 75° C	>5.56 - >7.88	>5.6 - >7.76
Disinfecting only at 75° C	>5.56 - >7.88	>5.6 - >7.76
Complete 3-step cycle (with disinfection at 80° C)	>5.56 - >7.88	>5.6 - >7.76

- Detergent was mix of anionic and nonionic surfactants, phosphates
- Bleach:  $H_2O_2$  agent; Disinfecting agent was peroxyacetic acid,  $H_2O_2$ , acetic acid Starting inocula:  $10^6-10^7$  CFU in 1 square cm The disinfecting step by itself could not remove stains

Fijan S, et al. Diag Microbiol Infect Dis 2007; 57: 251-257

• E. faecium had the greatest survival; Gram positive > Gram negative



### Laundry Transport / Storage



- · Separate clean textiles from contaminated textiles when transporting in a vehicle
- Physical barriers and/or space separation
- Clean, unwrapped textiles can be stored in a clean location for short periods of time
- Unwrapped textiles should be stored so to prevent inadvertent contamination by soil or body substances
- · This is the part of the overall process that is most vulnerable to outside contamination



# Chain of Infection (COI)





- · Virulent pathogen:
  - Bacteria, fungi, viruses, parasites, prions
- Sufficient number of pathogen:
  - Infectious dose
- Mode of transmission:
  - Contact, droplet, airborne
- Portal of entry:
  - Broken skin, mucous membrane, respiratory tract, ingestion
- Susceptible host:
  - Age, immunity, medical conditions

Other possible links include reservoir, portal of exit

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## Mucormycosis **Outbreak** and **Hospital Textiles**

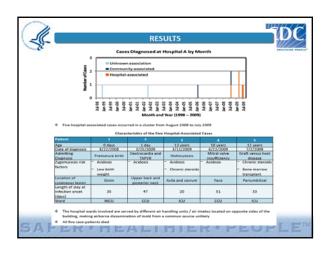
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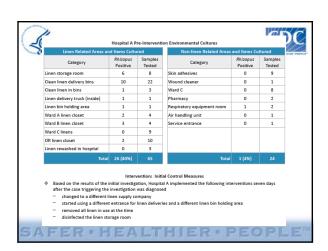


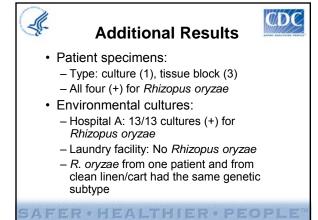
### Mucormycetes



- · Mucormycetes are ubiquitous molds
- 23 pathogenic species; Genus Rhizopus causes half of all infections
- · Rhizopus oryzae most common; genetic variety observed within species
- · Mucormycosis:
  - Skin is common site of infection
  - Invasive mold: fatality rate highly variable (ranges from 10% - 94%)









# **Conclusions From the Outbreak Investigation**



- Hospital linens were the most likely vehicle to have brought *Rhizopus* in contact with the patients
- Genetic subtyping of fungal isolates supported this epidemiologic hypothesis
- Contamination of clean linens with Rhizopus happened repeatedly, but might have been intermittent
- Hospital linens should be laundered, shipped, and stored in a manner that minimizes exposure to environmental contaminants

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### Let's Talk About...



- A variety of textile / fabric item management questions
- Textiles in isolation care areas
- Management of textiles and Clostridium difficile
  - Keeping upholstered furniture and carpeting clean
  - Privacy curtains
  - General patient care areas: textiles with body substance contamination
- Laundering of HCW uniforms
- Residential outerwear laundering issues
  - Home or facility laundering?

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# Management of Textiles from Isolation Care Areas



- Soiled textiles from isolation care areas can be laundered with textiles from general patient care areas
- Key principles for handling soiled textiles in isolation care areas
  - Use minimal agitation, avoid aerosol production
  - Minimize skin and clothing contact with soiled textiles
    - · Isolation gown can protect HCW outerwear
  - Contain soiled textiles in designated laundry bags or bin for collection

CDC/HICPAC Isolation guideline 2007: http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pd

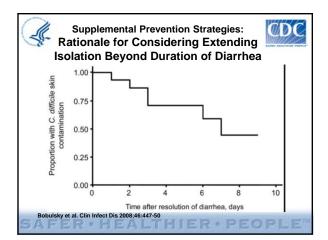


# Where Has *C. difficile* Contamination Been Found?



- Pulvirenti JJ, et al. Infect Control Hosp Epidemiol 2002; 23: 641-7.
  - Patient-Care Areas (HIV unit, ID unit):
    - Floors, bed rails, common toilets, portable toilets, communal blood pressure cuff
    - Positive environmental cultures:
      - Cook County Hospital: 14.7% (24/286)
      - Rush Presbyterian St. Luke's Med Center: 2.9% (3/104)
  - Outbreak strain (CD1A) at Cook County Hospital was detected in the environment 1 month after index outbreak patient was identified

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# Textile Management and *C. difficile* Contamination



- Consider cohorting symptomatic patients/ residents' clothing to wash separately from clothing of healthy residents
- During a wash cycle, do not mingle used cleaning cloths in with clothing from healthy residents
  - High numbers of spores may remain on the cloths if used with a non-sporicidal disinfectant
  - Use of sporicidal disinfectant will reduce the viable spore number

From: Carbone HL, et al. 2010 Decennial Infection Prevention and Epidemiology Conference, poster #160



# Furniture, Carpeting, and Privacy Curtains



- · Upholstered furniture and carpeting:
  - Chain of Infection point: although pathogens have been found on these surfaces, little evidence of transmission
  - Professionally clean with appropriate EPA-registered sanitizer at least once a year and after significant body substance contamination
  - Consider use of protective cover for upholstered chair seat
- Privacy curtains:
  - Edges become contaminated: select a curtain whose edges can be easily cleaned and disinfected
  - Preference: replace with a clean curtain during terminal cleaning

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### Definition of Contaminated Laundry



#### OSHA definition:

Contaminated laundry: laundry which has been soiled with blood or other potentially infectious materials or may contain sharps.

Use PPE when handling these textiles and place in appropriate containment for collection.

Source: 29 CFR 1910. 1030 OSHA Bloodborne Pathogen Standard

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### Scrubs/Uniforms vs. PPE



- · Employer responsible for laundering:
  - PPE made of reusable fabric
  - Reusable fabric scrubs/uniforms that have been contaminated with blood and/or OPIM
- Reusable fabric scrubs/uniforms not contaminated with blood and/or OPIM
  - Chain of Infection point: although microbes have been identified on this outerwear, little direct evidence of transmission
  - Ongoing debate as to whether or not these can be laundered at home safely
  - AORN recommends that scrubs be laundered by the employer



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# Resident Clothing



- · Chain of Infection point: although pathogens have been found on clothing, little evidence of direct transmission
- · Challenge: making resident care facilities more of a residence
- · Establish policy/procedures for resident clothing:
  - Determine what items will be laundered by the facility
  - Note laundering instructions for garments
  - Develop a laundering strategy
    - Water temperature, laundry additives, dryer temperature

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### **CDC / HICPAC Guidelines:** Laundry and Bedding



From the "Guidelines for Environmental Infection Control in Health-Care Facilities" (2003):

Epidemiology and General Aspects of Infection Control

Collecting, Transporting, and Sorting Contaminated Textiles and Fabrics Parameters of the Laundry Process Special Laundry Situations

Surgical Gowns, Drapes, and Disposable Fabrics

Antimicrobial-Impregnated Articles and Consumer Items Bearing Antimicrobial Labeling

Standard Mattresses, Pillows, and Air-Fluidized Beds



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### The HLAC Standard for 2011



- · Supersedes the HLAC Standard of 2006
- . More detailed, less ambiguity
- Comprehensive in scope
- Thoroughly referenced
- Its message: Patientfocused infection prevention
- Advances the industry

HLAE 3	The Healthcare Laundry Accreditation
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- Guidelines for Environmental Infection Control in Health-Care Facilities:
- http://www.cdc.gov/hicpac/pdf/guidelines/eic\_in\_HCF\_03.pdf
- Guidelines for Disinfection and Sterilization in Healthcare Facilities: http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection\_Nov\_2008.pdf
- HAI Prevention Tool Kit:

http://www.cdc.gov/HAI/prevent/prevention\_tools.html
 Options for Evaluating Environmental Cleaning

- Appendices to the Conceptual Program Model for Environmental Evaluation
- CDC Environmental Checklist for Monitoring Terminal Cleaning
   CDC Environmental Checklist
- Environmental Cleaning Evaluation Worksheet (Excel format)
- · CDI Prevention Tool Kit

□ EPA:

- Selected EPA-Registered Disinfectants:
  - http://www.epa.gov/oppad001/chemregindex.htm
- Pesticide Product Label System: http://www.epa.gov/pesticides/pestlabels/index.htm

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# Thank You!



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